

What's Growing On?

BASTROP COUNTY MASTER GARDENER ASSOCIATION

April 2021

Insects and the BIG FREEZE

By Wizzie Brown

With most of Texas seeing freezing temperatures in February, I've been getting numerous questions on what it will do to the insect populations this year. Since we haven't experienced such cold temperatures along with ice and snow for a long time, the short answer is that we just don't know and will have to wait and see. I have a feeling that the majority of insects- and other arthropods- will be just fine because they have ways of surviving winter's cold temperatures.

Just like "snowbirds" that drive their RVs to Texas or Florida to spend the winter, there are certain groups of insects that migrate to new areas to spend the winter where temperatures are not as cold. A great example of this is the Monarch butterfly.

Another example that can be put into "human relation" terms would be insects that use cryoprotectants (anti-freeze compounds). The most commonly used compound that insects use for this purpose is ethylene glycol, which is the same compound that is in antifreeze that humans put into vehicles. Ethylene glycol allows the insect's body tissues to supercool and remain above the freezing point.

Freeze tolerance is another modification that some insects use to survive winter temperatures. With this method, freezing causes water to be forced out of living cells and the fluid around the cells freeze. These insects also empty their digestive tract to get rid of any food that contains water which could freeze and cause the digestive system to burst. Freeze tolerance is easier for smaller insects due to the fact that they have less fluid in

(Continued on page 2)

Sustainability and Environment— Peat Moss Versus Coconut Coir

By Howard Nemerov

Are we depleting peatlands by extracting peat-moss for horticultural purposes? Is coconut coir a more environmentally sensitive and sustainable alternative? The answers to these questions may prove to be surprising.

Published articles generally fall short in presenting fact-based rationales against using peat. For example, a 2017 article in the *Washington Post* opened by citing an alleged authority who built a business selling a peat alternative. It also cites horticultural organizations that recommend reduction or elimination of peat usage, without detailing why they promoted these policies.¹ These articles lack factual analysis to determine if peat harvesting depletes peatlands or damages the environment, nor do they provide scientific reasoning to justify alternative recommendations.

Some university Extension agencies have also weighed in on peatland management. For exam-

(Continued on page 3)

Inside this issue:

Insects and the Big Freeze (continued)	2
"Sticky Weed"	2
Peat Moss vs. Coconut Coir (continued)	3-10

(Continued from page 1)

their body because of their small size.

Some insects may gather together to create collective heat. Honey bees do this inside the hive during the winter to keep warm.

Other insects seek areas of shelter in areas where it is not so cold. An example is ladybugs that move indoors during colder months of the year. These insects move into homes through cracks and crevices or other areas that are not well sealed when it gets cold. This can lead them indoors to become nuisance pests.

For more information or help with identification, contact Wizzie Brown, Texas AgriLife Extension Service Program Specialist at 512.854.9600. Check out my blog at www.urban-ipm.blogspot.com

This work is supported by Crops Protection and Pest Management Competitive Grants Program [grant no. 2017-70006-27188 /project accession no. 1013905] from the USDA National Institute of Food and Agriculture.

The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by Texas A&M AgriLife Extension Service or the Texas A&M AgriLife Research is implied.

The Texas A&M AgriLife Extension Service provides equal access in its programs, activities, education and employment, without regard to race, color, sex, religion, national origin, disability, age, genetic information, veteran status, sexual orientation or gender identity.

TEXAS A&M
AGRI LIFE
EXTENSION

Volunteering

Master Gardeners volunteer in the community to teach others about horticulture. We follow the research-based recommendations of Texas A&M AgriLife Extension. Members who complete 50 hours of volunteer service in the year after training earn the designation “Texas Master Gardener.” We use our title only when engaged in Texas A&M AgriLife Extension activities.

“Sticky Weed”

By Carolyn Turman

Have you been “attacked” by the native plant *Galium aparine*, commonly called “sticky weed” or “cleavers”? This plant is growing everywhere this spring and has some interesting qualities. It is edible, has some medicinal value, and can help prevent erosion.¹

As a native plant enthusiast, as well as a Master Gardener and a Master Naturalist, my goal is to stir your interest and appreciation in native plants in our area. Although there are many native plants we think are weeds or undesirable, they often have value beyond their benefits for our wildlife. If you want further information about



Galium aparine, read the Native Plant Society article in the bibliography.² Although Daniel Cunningham with Texas A & M University does not have this plant listed on his “wild-plant-foraging-list”, it has a variety of other native plants to consider.³

Endnotes

¹ Tull, Delena. “Edible and Useful Plants of the Southwest.” University of Texas Press, Austin. September 2013.

² Cywinski, Rachel. “Stuck on Velcro plant.” Native Plant Society of Texas, April 1, 2021. Accessed April 3, 2021. <https://us4.campaignarchive.com/?e=46471b00e9&u=1180e30d135dbab6014d2ddf1&id=9f3ea5ad46>.

³ Cunningham, Daniel. “Wild edible plant foraging list.” Texas A&M AgriLife Research and Extension Center at Dallas. Accessed April 4, 2021. <https://wateruniversity.tamu.edu/media/1326/wild-plant-foraging-list.pdf>

(Continued from page 1)

ple, an Oregon State University author writes: “Wetland ecologists say that peat is being harvested at non-sustainable rates.”² The author doesn’t identify these “wetland ecologists” nor provide any links to corroborative research. The author promotes the idea that coconut coir is a “sustainable alternative” without vetting whether coir production satisfies the same ecological criteria applied to peat moss.

Peat moss harvesting does indeed disrupt Nature. Bogs must be drained and dried, so that heavy equipment can remove surface vegetation and harvest the peat, which is transported to processing facilities. Packaged peat moss products get carried by hydrocarbon-consuming vehicles to their final destination for sale to greenhouses and the public.³ This paper examines two main questions:

- ◆ What is horticultural peat moss production’s impact on the environment?
- ◆ How does coconut coir compare after applying the same environmental criteria?

Peat moss industry: propaganda machine or informed choices?

The Canadian Sphagnum Peat Moss Association [CSPMA] represents most of the major producers via direct membership and affiliation with regional peat producer associations, representing about 87% of all peatlands under production. Their stated goals extend beyond peatland management standards to “leadership in environmental and social stewardship and economic wellbeing related to the use of Canadian peatland resources.”⁴

The Canadian Sphagnum Peat Moss Association works with government agencies and Scientific Certification Systems Global Services [SCS Global, discussed below], an independent, third-party certification agency. These stakeholders developed a set of policies and practices that “guarantees the application of good management practices in all aspects of sustainable development.”⁵

As an example of the CSPMA working directly with government agencies, the Province of Alberta published a document entitled “Requirements for Conservation and Reclamation Plans for Peat Operations in Alberta.” The Acknowledgements section lists six government representatives, three from peat companies, and one from the CSPMA.⁶ The guide acknowledges the need for a holistic approach to environmental preservation:

*While this guide is focused towards reclaiming disturbed peatlands, it recognizes that other land use types may be disturbed and the importance of reclaiming the entire disturbance resulting from the peat operation.*⁷

Companies not members of the CSPMA must operate under government guidelines when harvesting Canadian peatmoss. For example, Alberta outlines requirements for conservation, management, and restoration of peatlands in public lands.⁸ Other provinces have similar regulations. For example, New Brunswick has requirements addressing “construction, operation and reclamation.”⁹

According to the CSPMA, peat grows slowly:

*Peatlands are ecosystems where the production of biomass exceeds its decomposition. The result is the accumulation of organic matter coming from plant debris and especially Sphagnum mosses that dominate peatland vegetation. This more or less decomposed plant biomass forms the peat. Sphagnum mosses grow a few centimetres a year in height, but because of the subsequent decomposition and compaction processes, the rate of accumulation of peat is only about 0.5 to 1 mm per year.*¹⁰

(Continued on page 4)

(Continued from page 3)

This means it takes between 1,000 and 2,000 years to produce a one-meter layer of horticultural grade peat moss. The CSPMA reports: “An average depth of 2 m [2 meters] is generally considered to be a minimum” to qualify for harvesting.¹¹ Simple math indicates that peatlands currently being harvested began forming at least 2,000 to 4,000 years old.

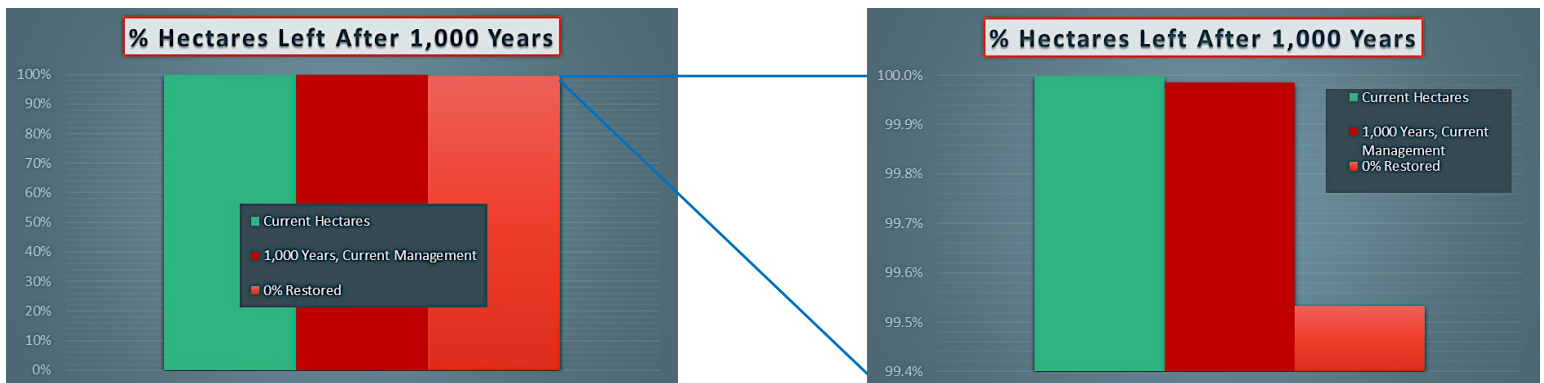
The CSPMA published statistics discussing current peatlands under production.¹² As of 2017, they report that 3% of post-production peatlands have been converted to other land use, mostly agriculture.¹³ The rest gets restored to productive peatland environments.

Stéphanie Boudreau is the CSPMA Science Coordinator, and works directly with Canadian governmental organizations. She is one of the contributors acknowledged in Alberta’s “Requirements for Conservation and Reclamation” mentioned above, and was willing to provide information regarding the peat moss industry’s impact on Canadian peatlands.

Using data provided by Ms. Boudreau—such as the 3% post-harvest loss—allows us to calculate a more precise picture of how peat harvesting impacts Canada’s peatlands. Since the industry began around World War II, 31,675 hectares (78,271 acres) have been harvested, averaging over 400 hectares (988 acres) per year. (Note: one hectare equals 10,000 square meters or 2.47 acres.) Harvesting has increased since 2014 to between 700 and 1,600 hectares annually. At the same time, 300 to 1,000 hectares close annually. Averaging these ranges means that about 500 additional hectares (1,236 acres) go into production annually.¹⁴

This provides enough data to calculate a “worst-case scenario” on how much Canada’s peatlands shrink each year due to harvesting. Projecting the 3% annual loss into the future, Canada loses 15 hectares (37 acres) annually from harvesting operations. Over the next 1,000 years, Canada would lose 79,676 hectares of peatlands (196,884 acres).

Here’s why perspective is so important: There are currently 113,600,000 hectares or 280,711,713 acres (438,612 square miles) of Canadian peatlands;¹⁵ the annual loss is 0.0000132% of current total peatlands, or just over 1/100,000th of a percent (15 hectares lost annually divided by the original 113,600,000 hectares). One thousand years from now, the total loss would represent 0.014% of the original total: Canada’s peatlands would retain 99.986% of the original area. By comparison, if industry and government had no interest in peatland restoration, at the current usage rate, Canada would lose 531,175 hectares (1,312,562 acres) over the next 1,000 years, leaving 99.5324% of Canada’s peatlands intact. Rounding to the nearest integer—100%—it could be argued that the current commitment to restoration makes peat harvesting sustainable.



Blue lines break out top 99.4% of left graph to display theoretical outcomes in restoration management.

(Continued on page 5)

(Continued from page 4)

The first scenario—near-zero loss—is more likely than the second. It’s also possible that the 3% annual loss will diminish in the future. Ms. Boudreau reported that restoration science is relatively new, and that government regulations are likely to tighten in the future:

*There has been a great deal of research since 1992 on peatland restoration and it is now possible to restore a peatland, which was not the case 30 years ago, for example. So the options that were considered in 1990 when closing a site are not the same as now. Moreover, the regulations in all provinces have evolved with the research and a peatland that is open today for peat harvesting will have a legal obligation to be restored after, unless there is a good reason to choose another option.*¹⁶

There are other indicators that the peat harvesting industry is serious about sustainability and the environment:

- ◆ Peat companies work with conservation groups to develop standards for peatland conservation and restoration.¹⁷
- ◆ The CSPMA published standards for issues like environmental stewardship and the work environment (e.g., labor rights, health and safety).¹⁸

Veriflora®—Certifying sustainability

The CSPMA’s relationship with Veriflora provides more checks and balances by ensuring responsible approaches to both peatland and business management.

Regarding their peatmoss program, SCS Global notes:

*The certification program was developed in 2012 in collaboration with CSPMA and APTHQ [Québec Peat Moss Producers Association], representatives of the U.S. and Canadian governments, academic experts and horticultural peat producers. This certification was originally an annex to the Veriflora Standard, a certification in sustainable development applied to the fields of floriculture and horticulture.*¹⁹

Veriflora certified members must practice “sustainable ornamental horticulture.”²⁰ They also must follow Veriflora’s “comprehensive framework and common set of environmental, social, and quality requirements by which to identify and encourage responsible horticultural peat moss production practices and to stimulate continuous improvement in the peat moss industry.”²¹

Veriflora standards cover a broad range of subjects, from business ethics to peatland management. Their standards document covers subject like:

- ◆ Restoration and Rehabilitation: requirements for rehabilitation plan; monitor and ensure rehabilitation plan is fully executed.²²
- ◆ Fair labor practices: hiring practices; non-discrimination; right to organize.²³
- ◆ Community benefits: environmental protection and community engagement.²⁴

Kevin Warner, Veriflora’s Manager of Sustainable Horticulture, explained:

The most credible audits need to ensure that practices are implemented year-round, not just for the few days that an auditor is on site. We audit the management system to ensure that

(Continued on page 6)

the sustainable agriculture practices we require are being implemented, and through our rigorous process we can ensure that a sustainable management system is being implemented on the ground (and not just documented in a binder in the office).²⁵

The point here is how CSPMA has a three-layer program—government, third-party certifying agency, and association members—geared towards creating a sustainable management system and a sustainable product.

Organic Materials Review Institute

Some peat and coconut coir products advertise their Organic Materials Review Institute (OMRI) approval, demonstrating their organic bona fides. The United States Department of Agriculture (USDA) notes: “Organic standards are designed to allow natural substances in organic farming while prohibiting synthetic substances.”²⁶

Organic Materials Review Institute is a private, third-party certifier that “determines which input products are allowed for use in organic production and processing.”²⁷ OMRI certification verifies that the product is from natural sources. This doesn’t certify safety regarding possible environmental or economic impacts from producing or using that product.

Coconut coir as peat alternative

Coconut coir offers its own benefits:

- ◆ It’s functionally similar to peat in creating light potting mixes with good root penetration, and enhances water and nutrient holding capacity.
- ◆ It’s more hydrophilic than peat. It can be easily rewetted if it dries out; peat moss resists being rewetted once dry, potentially causing root damage if root hairs can’t stay hydrated.²⁸

According to an Associated Press article, “The main contender stepping into peat’s shoes is a material called coir dust, or cocopeat.”²⁹ While overstating that 95% of England’s bogs have been lost in the last hundred years, it’s true that less than 20% remain in a “natural or near-natural condition.”³⁰ However, the author provided no evidence of similar degradation in Canadian peat bogs, nor any science to explain why coir is better. An inquiry to the author has gone unanswered for months.

Coconut coir has become a financially attractive export for India and Sri Lanka. According to India’s Coir Board:

Currently, the global annual production of coir fiber is about 350,000 metric tons (MT). Yet, even in the world’s top two producers, India and Sri Lanka, which account for about 90% of global coir fiber production, combined, this renewable resource is underutilized; local coir mills process only a fraction of the available husks, which accrue more or less year-round as a waste during coconut processing.³¹

But is coconut coir “waste”? Each fall many homeowners remove bags of fall leaves to the curb for garbage pickup after cleaning this “waste” off their lawns. In nature, leaves break down, providing nutrients and organic matter that are “essential to building healthy soils and to the important roles soil plays in nature.”³² Leaf removal is so prevalent that Texas A&M AgriLife Extension published an online compost-

ing primer entitled “Don’t Bag It™ – Compost It!”³³

*Organic landscape materials, including leaves, woody trimmings and grass clippings often contribute significantly to a communities’ annual solid waste. During peak leafdrop in fall when residents are bagging and placing leaves curbside, organic materials may account for as much as 50% of the incoming landfill volume.*³⁴

Removing coconut coir as “waste,” processing it, and shipping it overseas presents other concerns. Like fall leaves, coir is organic matter not returned to the soil. Instead, it’s exported, permanently removing organic matter and nutrients from native soils. If soil quality degrades, so does agricultural production.

According to one coconut coir producer and North American importer, processing involves two steps that involve fresh water.

*The top graded coco pith is left in a clean weed free cement floor for over 18 months. During this time, the monsoon rain washes off excess salts from the coco pith and make the coco pith pH neutral. The coco pith is also washed with fresh water to bring the pH and Electric Conductivity to desired level.*³⁵

“Excess salts” may get washed into the local environment during monsoons, negatively impacting rivers and lakes.³⁶ India’s wetlands have already experienced “substantial decline” due to “rapidly expanding human population, large-scale changes in land use/land covers, burgeoning development projects, and improper use of watersheds.”³⁷

Coconut coir usually arrives in North America via container ships,³⁸ which typically carry 1.5–4.5 million gallons of fuel oil.³⁹ Air pollution has historically concentrated along global shipping routes, though new regulations aim to curtail this problem.⁴⁰



Finally, coir production means coconut plantations (picture on left). One Sri Lanka coconut water producer says coconut trees begin producing in 5–7 years, with nuts maturing in another 9 months.⁴¹ With a minimum lifecycle of up to eight years to produce one crop, coconut trees aren’t conducive to crop rotation aimed at minimizing fertilizer and pesticide inputs, preventing soil erosion, and increasing soil organic matter, among other benefits of rotating.⁴² Continuous monoculture can also negatively impact biodiversity.⁴³

Months ago, I have contacted Planet Coco, EverythingCoir Co., LLC—an OMRI approved coir manufacturer⁴⁴—and three officers of India’s Federation of Indian Coir Exporters’ Association.⁴⁵ None of them replied to my inquiries regarding the concerns discussed above.

Coir sells at a premium. At one online retailer, a compressed coir block that expands into 2.5 cubic feet costs \$20.45, or \$8.18 per cubic foot.⁴⁶ A 3.8 cubic foot, compressed peat bale sold by a CSPMA member company sells for \$14.99; \$3.95 per cubic foot, 48% the cost of coir.⁴⁷

Coconut coir or peatmoss? The peatmoss industry presented evidence of:

- ◆ Ever-increasing government regulation of peatlands, focusing on post-harvest restoration.
- ◆ Industry goals of environmental responsibility and ethical business practices.

(Continued from page 7)

- ◆ Transparency via third-party certification regarding economic and environmental sustainability.

Meanwhile, the coconut coir industry provided no evidence their product is the better choice, and research shows horticultural coir consumption may pose environmental risks and economic fallout in producing countries.

Special thanks to Dr. Joe Masabni, Texas A&M Extension Vegetable Specialist, for reviewing and offering editorial advice.

Endnotes (continued on pages 9–10)

¹ Higgins, Adrian. “Is this popular gardening material bad for the planet?” Washington Post, May 11, 2017. Accessed December 30, 2020. https://www.washingtonpost.com/lifestyle/home/should-sustainable-gardeners-use-peat-moss/2017/05/09/1fc746f0-3118-11e7-9534-00e4656c22aa_story.html

² McMahon, Linda R. “Coir is sustainable alternative to peat moss in the garden.” OSU Extension, June 2006. Accessed December 31, 2020. <https://extension.oregonstate.edu/news/coir-sustainable-alternative-peat-moss-garden>

³ “Harvesting Peat Moss.” Peat and Peatlands. Accessed April 21, 2021. <https://peatmoss.com/responsible-production/peat-harvesting/>

⁴ “Canadian Sphagnum Peat Moss Association.” Accessed October 16, 2020. <https://peatmoss.com/peat-moss-organisations/canadian-sphagnum-peat-moss-association/>

⁵ “Certification for Responsible Peatland Management.” Canadian Sphagnum Peat Moss Association. Accessed July 16, 2020. <https://peatmoss.com/responsible-production/certification-and-industry-policies/>

⁶ “Requirements for Conservation and Reclamation Plans for Peat Operations in Alberta.” Published by Alberta Government, May 25, 2016, page 2. Accessed November 9, 2020. <https://open.alberta.ca/publications/9781460129302>

⁷ “Requirements for Conservation and Reclamation Plans for Peat Operations in Alberta.” Published by Alberta Government, May 25, 2016, page 3. Accessed November 9, 2020. <https://open.alberta.ca/publications/9781460129302>

⁸ “Allocation and Sustainable Management of Peat Resources on Public Lands.” Alberta Government, January 17, 2017. Accessed December 9, 2020. <https://open.alberta.ca/dataset/a3866d2b-d28c-40fb-ac84-ee270e936d0/resource/0b5dc1ec-3572-4e3c-97ae-578771369b4f/download/peatallocationpublicland-dec16-2016.pdf>



New Website Features

Check out our website, which features project slideshows, a new photo gallery section, and an events calendar to check out upcoming activities. Find news articles and our newsletters. Thanks to Dave Posh for keeping the info timely for us <https://txmg.org/bastropcounty/>

- ⁹ Scotts Canada, Ltd. “Peatland 524 Expansion Project.” Government of New Brunswick, May 2017. Accessed December 9, 2020. <https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/EIA-EIE/Registrations-Engagements/documents/EIARegistration1466/EIARegistration1466.pdf>
- ¹⁰ Quinty, François and Rochefort, Line. “Peatland Restoration Guide: Second Edition.” Published by Canadian Sphagnum Peat Moss Association and New Brunswick Department of Natural Resources and Energy, copyright 2003, page 3. Accessed July 16, 2020. http://www.gret-perg.ulaval.ca/uploads/tx_centrecherche/Peatland_Restoration_guide_2ndEd.pdf
- ¹¹ “Harvesting Peat Moss.” Canadian Sphagnum Peat Moss Association. Accessed July 16, 2020. <https://peatmoss.com/responsible-production/peat-harvesting/>
- ¹² 2017 Statistics about Peatland Areas Managed for Horticultural Peat Harvesting in Canada. Accessed April 19, 2021. https://tourbehorticole.com/wp-content/uploads/2020/01/Summary_2016_2017_Indutry_Statistic_AREAS_WEB.pdf
- ¹³ Ibid, page 1.
- ¹⁴ Email conversation with Stéphanie Boudreau, Canadian Sphagnum Peat Moss Association, July 23, 2020.
- ¹⁵ “Peatlands of Canada Database and Maps.” Government of Canada. Accessed December 3, 2020. <https://geoscan.nrcan.gc.ca/text/geoscan/metadata/of6561-e.pdf>
- ¹⁶ Email conversation with Stéphanie Boudreau, Canadian Sphagnum Peat Moss Association, July 23, 2020.
- ¹⁷ Joosten, Hans and Clarke, Donal. “Wise Use of Mires and Peatlands.” International Mire Conservation Group and International Peat Society, copyright 2002. Accessed October 20, 2020. http://www.imcg.net/media/download_gallery/books/wump_wise_use_of_mires_and_peatlands_book.pdf
- ¹⁸ Canadian Sphagnum Peat Moss Association. “Industry Social Responsibility Report.” Published 2014. Accessed December 25, 2020. https://tourbehorticole.com/wp-content/uploads/2015/07/CSPMA_ISR_Report_2014_web_LW.pdf
- ¹⁹ “Certification and Industry Policies.” Canadian Sphagnum Peat Moss Association. Accessed November 9, 2020. <https://peatmoss.com/responsible-production/certification-for-responsible-peatland-management/>
- ²⁰ “Veriflora Sustainably Grown: Certification for Sustainable Ornamental Horticulture.” SCS Global Services. Accessed July 16, 2020. <https://www.scsglobalservices.com/services/veriflora-certified-sustainably-grown>
- ²¹ “Responsibly Managed Peatlands.” SCS Global Services Veriflora Program, August 2017, page 1. Accessed July 17, 2020. https://cdn.scsglobalservices.com/files/program_documents/scs_stn_responsiblymanagedpeatlands_v1-0_080217_new.pdf
- ²² Ibid, pages 8–9.
- ²³ Ibid, pages 15–24.
- ²⁴ Ibid, pages 24–26.
- ²⁵ Kevin Warner. Manager, Business Development, Sustainable Agriculture, Veriflora. Email October 21, 2020.
- ²⁶ McEvoy, Miles. “Organic 101: Allowed and Prohibited Substances.” United States Department of Agriculture. Accessed July 17, 2020. <https://www.usda.gov/media/blog/2012/01/25/organic-101-allowed-and-prohibited-substances>
- ²⁷ “Who We Are.” Organic Materials Review Institute. Accessed July 17, 2020. <https://www.omri.org/about>
- ²⁸ Higgins, Adrian. “Is this popular gardening material bad for the planet?” Washington Post, May 11, 2017. Accessed December 30, 2020. https://www.washingtonpost.com/lifestyle/home/should-sustainable-gardeners-use-peat-moss/2017/05/09/1fc746f0-3118-11e7-9534-00e4656c22aa_story.html
- ²⁹ Reich, Lee. “Consider easy, more sustainable alternatives to peat moss.” Associated Press, December 31, 2019. Accessed August 9, 2020. <https://apnews.com/b47bc887310e473fb0a485a3db2486fe>

- ³⁰ Bain, C.G., Bonn, A., Stoneman, R., Chapman, S., Coupar, et al. “IUCN UK Commission of Inquiry on Peatlands. IUCN UK Peatland Programme, Edinburgh.” IUCN UK Peatland Programme. Accessed December 3, 2020. www.iucn-uk-peatlandprogramme.org/sites/www.iucn-uk-peatlandprogramme.org/files/IUCN%20UK%20Commission%20of%20Inquiry%20on%20Peatlands%20Full%20Report%20readerview.pdf
- ³¹ “Global Coir Trade” Coir Board, Ministry of Micro, Small, and Medium Enterprises, Government of India. Accessed August 9, 2020. http://coirboard.gov.in/?page_id=127
- ³² Muth, Allyson Brownlee. “Fallen Leaves? An argument for not raking.” Penn State Department of Ecosystem Science and Management, October 25, 2016. Accessed August 9, 2020. <https://ecosystems.psu.edu/research/centers/private-forests/news/2016/fallen-leaves-an-argument-for-not-raking>
- ³³ “Don’t Bag It™ – Compost It!!” Texas A&M AgriLife Extension Service. Accessed October 16, 2020. <https://aggie-horticulture.tamu.edu/earthkind/landscape/dont-bag-it/>
- ³⁴ “Introduction | Don’t Bag It™.” Texas A&M AgriLife Extension Service. Accessed October 16, 2020. <https://aggie-horticulture.tamu.edu/earthkind/landscape/dont-bag-it/introduction-dont-bag-it/>
- ³⁵ “Manufacturing Process.” Planet Coco. Accessed August 9, 2020. <http://www.planetcococoir.com/manufacturing-process.php>
- ³⁶ “Clean Water is Everybody’s Business.” United States Environmental Protection Agency, revised March 2005. Accessed August 9, 2020. https://www.epa.gov/sites/production/files/2015-09/documents/ag_runoff_fact_sheet.pdf
- ³⁷ Mareddy, Anji Reddy. “Impacts on the biological environment.” Environmental Impact Assessment, 2017. Accessed August 9, 2020. <https://www.sciencedirect.com/topics/engineering/agricultural-runoff>
- ³⁸ “Manufacturing Process.” Planet Coco. Accessed August 9, 2020. <http://www.planetcococoir.com/manufacturing-process.php>
- ³⁹ “How many gallons of fuel does a container ship carry?” International Shipping News, January 20, 2020. Accessed August 9, 2020. <https://www.hellenicshippingnews.com/how-many-gallons-of-fuel-does-a-container-ship-carry/>
- ⁴⁰ Gallucci, Maria. “At Last, the Shipping Industry Begins Cleaning Up Its Dirty Fuels.” *Yale Environment* 360, June 28, 2018. Accessed August 9, 2020. <https://e360.yale.edu/features/at-last-the-shipping-industry-begins-cleaning-up-its-dirty-fuels>
- ⁴¹ Eliya blog, May 11, 2018. Accessed October 16, 2020. <https://www.eliyanyc.com/blog/2018/5/1/life-cycle-of-a-coconut>
- ⁴² “Crop Rotation.” Natural Resources Conservation Service, United States Department of Agriculture. Accessed October 16, 2020. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/?cid=nrcs142p2_044349
- ⁴³ McGuire, Andrew. “Ecological Theories, Meta-Analysis, and the Benefits of Monoculture.” Washington State University, May 26, 2015. Accessed August 10, 2020. <http://csanr.wsu.edu/theories-meta-analysis-monocultures/>
- ⁴⁴ “EverythingCoir Co., LLC.” Accessed October 16, 2020. <https://www.omri.org/mfg/evc>
- ⁴⁵ Contact Us. Federation of Indian Coir Exporters’ Associations. www.ficea.in
- ⁴⁶ “Coconut Coir.” A.M. Leonard Horticultural Tool & Supply Co., Accessed April 20, 2021. <https://www.amleo.com/coconut-coir-block-5-kilograms/p/COIR5>
- ⁴⁷ “Lambert Retail Peat Moss, 3.8 CF.” A.M. Leonard Horticultural Tool & Supply Co., Accessed April 20, 2021. <https://www.amleo.com/lambert-retail-peat-moss-38-cf/p/LRPM/>